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**FINAL REPORT ON PCB USAGE AT THE
GRAND JUNCTION AREA OFFICE FACILITY**

**Field Engineering
Corporation**

Grand Junction Operations
Grand Junction, CO 81502

June 1982

PREPARED FOR THE U.S. DEPARTMENT OF ENERGY
Assistant Secretary for Nuclear Energy
Grand Junction Area Office, Colorado

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FINAL REPORT ON PCB USAGE AT THE GRAND JUNCTION
AREA OFFICE FACILITY

Marvin E. Miller, Maintenance Planner

and

Stephen Donovan, Geochemical Analyst

June 1982

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BENDIX FIELD ENGINEERING CORPORATION
P.O. Box 1569
Grand Junction, Colorado 81502

PREPARED FOR THE U.S. DEPARTMENT OF ENERGY
Assistant Secretary for Nuclear Energy
Grand Junction Area Office
Grand Junction, Colorado 81502
Contract No. DE-AC07-76GJ01664

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INTRODUCTION

On April 15, 1981, a memo discussing polychlorinated biphenyl (PCB) usage at U.S. Department of Energy (DOE) facilities was issued by the DOE Office of Environmental Compliance and Overview. It directed the heads of all DOE field organizations to "assure that any relevant information regarding PCB use at Department of Energy facilities is made available to the EPA on a timely basis" by providing these data to the Office of Environmental Compliance and Overview "so that a Departmental response can be provided to the EPA."*

This memo and its attachments (copies of the Federal Register containing Government regulations concerning PCBs) were passed on to Bendix Field Engineering Corporation (Bendix) in late April 1981. As prime contractor for the Grand Junction Area Office (GJAO) DOE Facility, Bendix was directed to determine if any PCBs were in use on the Facility. If PCBs were found, Bendix was tasked with establishing a maintenance and recordkeeping system, as directed by the Federal Register, to monitor local PCB use.

Responsibility for Facility PCB identification (Project No. 4M0189 under Operations Work Request No. OP 1495) was given to Bendix Operations Division, Plant Engineering Department. This report summarizes the development, implementation, and results of the PCB identification project at GJAO.

PROJECT DEVELOPMENT

At the time the project was initiated, there was no clear description of what the actual PCB problem is, who maintains responsibility for PCB control, how that control is accomplished, and how the local problem at GJAO should be approached. Thus, the first step toward identifying the amount of PCBs in use at the GJAO Facility was to become more knowledgeable about PCBs and the problem surrounding them.

As research progressed on the PCB subject, it became apparent that to determine if PCBs were in use at GJAO, Plant Engineering would first have to identify the types of equipment that could contain them. In May 1981, there was no accurate available inventory of Facility electrical equipment. Performing such an inventory and compiling appropriate equipment lists would be required prior to identifying any PCBs in use.

Plant Engineering decided to handle the PCB identification project in several phases (see Figure 1). The first phase would require gathering, compiling, and studying information about PCBs in electrical equipment to assist in the performance of a meaningful Facility-wide inventory. The second phase would entail conducting a physical inventory of potential PCB-containing equipment. The third phase would require identifying any PCBs in use by using the data

*U.S. Department of Energy, "PCB Manufacturing, Processing, Distribution in Commerce and Use Prohibitions; Use in Electrical Equipment; Court Order on Inspection and Maintenance; and PCB Use in Electrical Equipment, Advanced Notice of Proposed Rulemaking," Federal Register, Vol. 46, No. 46, March 10, 1981, pp. 16090-16098; also DOE Memorandum, dated April 15, 1981.

Figure 1. Phase Breakdown of PCB Identification Project

gathered in Phases 1 and 2 and through correspondence with the appropriate equipment manufacturers. The fourth phase, if needed, would require investigating other available methods used to identify PCBs if the local PCB amounts could not be determined from the information gathered through Phase 3. The fifth phase would require using one of the methods studied in Phase 4 to calculate Facility PCB levels. The sixth phase would document the entire project and report on the total amount of PCBs in use at GJAO.

PROJECT IMPLEMENTATION

PHASE 1: PCB SUBJECT RESEARCH

The objective of Phase 1 was to learn more about PCBs and determine how complex a problem they might be at GJAO. Plant Engineering wanted to know (1) what the potential maintenance requirements would be for contaminated equipment; (2) how askarels (PCB solutions above 500 ppm) could be identified from manufacturer labels on the equipment; (3) how to dispose of PCBs, and (4) whether dilution of any askarels found would be permitted by regulations.

Research began in May 1981. It was first discovered that PCBs and their use at the GJAO Facility had been studied in 1976. The Energy Research and Development Administration (ERDA), the agency then operating GJAO, had directed Bendix to inventory PCB usage on the Facility. This directive resulted from a request made by the Environmental Protection Agency (EPA) asking all federal organizations to inventory their PCB usage and forward the results to EPA in order that EPA could establish a comprehensive management program for PCBs.* Bendix provided a report to ERDA in May 1976. The report, contained in Appendix A, made the broad assumption that all equipment that could be potential sources of PCBs did in fact contain PCBs. Therefore, the report only provided a calculated estimate of the total possible PCB contamination on the Facility; no attempt was made to determine actual PCB levels at GJAO.

Plant Engineering turned next to the Federal Register and current EPA and trade documentation. They learned that EPA defines a PCB as any chemical substance or substances containing the biphenyl molecule that has been chlorinated to any degree. A PCB Item can be any contaminated oil, askarel, or equipment containing PCBs at a level of 50 ppm or greater. PCBs have an oil-like consistency and weigh 10 to 12 pounds per gallon. They are commercially popular for their stability, low flammability, low solubility, high heat capacity, and favorable dielectric strength. PCBs are synthetically manufactured. Nearly all PCBs produced in this country were manufactured by the Monsanto Corporation between 1929 and 1977. Monsanto sold PCBs under the trade name Aroclor. Many other companies sold PCBs under one or more of the following trade names:

*Letter from the U.S. Environmental Protection Agency, to Robert C. Seamons, Jr., Administrator, Energy Research and Development Administration, dated March 10, 1976.

Aroclor	Diachlor	Phydraul
Aroclor B	Dykanol	Pyranol
Asbestol	Elemex	Pyroclor
Askarel	Eucarel	Saf-T-Kuhl
Clorextol	Hyvol	Santotherm Pyralene
Clorinol	Inerteen	Therminol
Clorphen	No-Flamol	

PCBs are an environmental hazard because they do not change into new chemical arrangements as time progresses. Instead, they gather on living tissue and increase in strength as they move up the food chain. Tests have revealed that PCBs cause gastric disorders, skin lesions, tumors, reproductive disorders, digestive problems, jaundice, impotence, headaches, and respiratory problems. Concern about PCBs is great because they have been shown to have long-term effects in many animals, even when exposure concentration is very low.*

With respect to the GJAO transformers and disconnects (the most likely sources of PCBs on the Facility), EPA regulations divide them into three classifications. The first classification, called PCB-Transformers, consists of those transformers containing PCBs at a concentration of 500 ppm or greater. A transformer must be classified a PCB-Transformer if the nameplate indicates a PCB dielectric is in the transformer, if the owner suspects it to contain PCBs greater than 500 ppm, or if the dielectric tests show PCBs at 500 ppm or greater. Until a positive identification of the dielectric fluid is made, all transformers must be considered PCB-Transformers.

The second classification, called PCB-Contaminated Transformers, includes those transformers containing between 50 ppm and 500 ppm PCBs. The EPA estimates that 25 to 40 percent of the transformers in use today fall into this classification.[†] Even transformers filled with mineral oil must be placed in this classification until the PCB levels in their reservoirs are proven to be less than 50 ppm. The third classification, called Non-PCB Transformers, identifies transformers having PCB levels less than 50 ppm.

There is no actual ban on the use of PCB Transformers or PCB-Contaminated Transformers as long as their use is in a totally enclosed manner. According

*U.S. Environmental Protection Agency, "EPA's Final PCB Ban Rule: Over 100 Questions and Answers to Help You Meet These Requirements," Office of Toxic Substances 75-799, Revised Edition, June 1980, p. 2-3.

[†]Ibid., p. 11.

to EPA, "totally enclosed manner" refers to PCBs used in such a way as to prevent any detectable exposure to the environment. Until a transformer containing PCBs at 50 ppm or greater begins to leak, there are no restrictions on its use. Once a detectable leak is found, EPA regulations require that disposal of the transformer and dielectric begin immediately.*

Nearly all manufacturers that distributed PCBs in their electrical products noted the type of askarel in the transformer on the manufacturer's label. Therefore, any equipment initially filled with an askarel should be easily identified during equipment inventory.

Sufficient information from research was gathered to conduct a comprehensive inventory of GJAO Facility transformers. Plant Engineering determined what information to extract from equipment nameplates and how to inspect equipment for any detectable leakage. The inventory was limited to Facility transformers and oil switches because it was decided that any PCBs contained in lighting ballasts, portable air conditioners, hydraulic systems, and miscellaneous PCB capacitors would not present a significant environmental hazard to food or feed products or to personnel.

PHASE 2: PHYSICAL INVENTORY

Inventory of Facility transformers and oil switches was accomplished in mid-May 1981. Data were gathered from 64 transformers and 3 oil switches. Of the 64 transformers inventoried, 9 were excluded from the project. Six of these nine were identified as dry-type transformers filled with an asphalt base compound. The other three were sealed, pad-mounted transformers with no visible access to the internal dielectrics. In addition, the more recent manufacture and/or reconstruction of these three transformers indicated that they probably contained no PCBs. Of the 55 transformers included in the project, 29 were located at substations, 9 were pole-mounted, and the remaining 17 were located in warehouse storage or in the scrap metal pile.

The Facility-wide inventory of transformers and oil switches required just over 16 man-hours to complete. Half this time was spent obtaining data from the nine pole-mounted transformers providing power to Facility lighting. Access to these transformers was gained through the use of a forklift-mounted light boom.

All 55 transformers contained an accessible liquid dielectric. There were no references to any askarels (discussed in Phase 1 of this report) on any transformer nameplates. Most transformer nameplates classified the dielectrics contained in their reservoirs as liquid, fluid, oil, mineral oil, #10C oil, or #10CA oil. Others made no mention of the dielectrics in their reservoirs. Although some units showed signs of past oil leakage, no fresh leaks were found on any Facility transformers. The old leaks did not appear to have contaminated any ground surrounding the substations or poles.

*U.S. Environmental Protection Agency, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce and Use Prohibitions," Federal Register, Vol. 43, June 7, 1978, p. 24805-6.

PHASE 3: INITIAL IDENTIFICATION OF PCBs

Once the inventory was complete and the data compiled and evaluated, the initial conclusion was that the PCB problem at GJAO was insignificant. However, a few questions remained unanswered. Assuming that 25 to 40 percent of the transformers in use today are PCB-Contaminated (as estimated by EPA), logic dictates that some evidence of PCB contamination should be found at GJAO. Since several transformer nameplates made no reference to the amount or type of dielectric fluids in their reservoirs, it is possible that these transformers are PCB-Contaminated. Another uncertainty involved whether any transformers could have become contaminated since the time that they were manufactured or purchased by GJAO.

To answer these questions, Plant Engineering began correspondence with various transformer manufacturers in June 1981, seeking information concerning the amount and type of fluids contained in the GJAO-owned transformers. Correspondence was initiated with the following companies:

Colt Industries Pine Bluff, Arkansas	Pennsylvania Electric Coil, Inc. Pittsburgh, Pennsylvania (owners of the Allis-Chalmers line of transformers)
Delta-Star Products Pittsburgh, Pennsylvania	
ESCO Manufacturing Corporation Greenville, Texas	T&R Electric Company, Inc. Colman, South Dakota
General Electric Corporation Denver, Colorado	Westinghouse Electric Sharon, Pennsylvania
Kuhlman Corporation Birmingham, Michigan	

Manufacturers' responses to this correspondence began arriving within one week of initial contact and continued until late October 1981. Five manufacturers responded by letter and two by telephone; T&R Electric Company, Inc., did not respond to any correspondence. All respondents, except the Kuhlman Corporation, claimed their products had been filled with oil or #10C oil at the time of their initial shipment from the factory. Colt Industries' response included a policy statement on non-PCB certification for their products. This statement claimed that all transformers manufactured by Colt since 1962 contained less than 1 ppm PCB in the dielectric. (The GJAO transformers made by Colt Industries are labeled with manufacturing dates prior to 1962.)

In August 1981, Plant Engineering was contacted by Mr. Bernie Bartlien, Sales Service Engineer for the General Electric Corporation in Denver, Colorado.

Discussions with Mr. Bartlien brought out several pertinent facts concerning transformer manufacture and PCBs. Even though transformer manufacturers may have released their products filled with oil, the transformers could still have been contaminated with PCBs while in the factory. During the 1940s and 1950s, most transformer manufacturers did not have explosion-proof testing facilities for their products. To reduce the possibility of explosion and fire during testing, manufacturers filled transformers under test with an askarel. When testing was completed, the transformer reservoirs were drained and then refilled with mineral oil. However, some askarel was normally retained on the walls and bottom of the reservoirs and within the transformers' windings. This askarel would contaminate the fresh mineral oil in the reservoir. Additionally, manufacturers often pumped askarel and mineral oil through the same pump and hose system without flushing the system in between. Both these actions could cause PCB contamination in the dielectric which might exceed the EPA-regulated minimum of 50 ppm. Mr. Bartlien recommended that Bendix should not assume the GJAO transformers were entirely free of PCBs based only on the information initially gathered by Plant Engineering.

In late August 1981, Mr. C. Milton of the Kuhlman Corporation contacted Plant Engineering regarding the GJAO transformers manufactured by his company. Mr. Milton, a long-time employee of Kuhlman, was able to determine which plant had manufactured the transformers and reported that he had worked in this plant during the time the GJAO-owned transformers were manufactured. In response to questions about plant-testing methods, Mr. Milton confirmed all of Mr. Bartlien's concerns regarding potential PCB contamination during manufacturer testing of transformers. He believed that, although the Kuhlman transformers had been filled with oil prior to shipment, there was still a strong possibility that those located at GJAO were contaminated with PCBs.

Several discussions were held by Plant Engineering to evaluate this information and to select a proper course of action. It was finally decided that only through an analysis of the transformer dielectrics could the exact amount of PCBs in use at GJAO be determined.

PHASE 4: ALTERNATIVE PCB IDENTIFICATION PROCEDURES

In order to find a suitable method for analyzing Facility transformer oils, Bendix personnel consulted a March 1979 report concerning the management of askarel transformers.* This report discussed three basic methods for determining whether PCBs are present in transformer-insulating fluids:

1. Calculated Density -- This method involves dividing the weight of the fluid in a transformer reservoir by its number of gallons and comparing this calculated fluid density with the known fluid densities of various askarels and oils. Those fluids with densities less than 8.0 lbs/gal are definitely oil; densities between 11 and 12.5 lbs/gal definitely indicate askarel.

*Robert Burruss, "Guide for the Management of Askarel Transformers, Final Report," Versar, Inc., Springfield, Virginia, supplied to Naval Facility Engineering Command, March 1979, p. 3.

2. Test of Density -- This method requires dropping a single drop of transformer dielectric fluid into a small amount of water. If the drop sinks, the fluid is an askarel; if it doesn't, it is an oil.
3. Chemical Analysis -- This method involves extracting dielectric samples from the equipment and performing chemical analysis on them, using a gas chromatograph.

The advantages and disadvantages of the three methods were compared. The first two methods are relatively simple and inexpensive to perform. The third method, involving chemical analysis, is more costly and complex. Use of the first two methods can only determine if the fluid is or is not an askarel (above 500 ppm PCB), and thus will not provide any information on intermediate PCB levels (50 to 500 ppm) in the fluids being tested. Also, the test of density creates a substantial amount of contaminated water that would require disposal. Chemical analysis, on the other hand, would provide an exact count of the PCB level in each sample tested. If the sample is extracted properly, the possibility of contamination is small. Since Plant Engineering wanted an exact count of PCB levels at GJAO, chemical analysis was felt to be the best approach for identifying the total amount of PCBs on the Facility.

At that time (October 1981), the nearest facility equipped to test insulating liquids for PCBs was the General Electric (GE) service shop in Denver, Colorado. In September 1981, a representative from Plant Engineering attended a GE seminar profiling their Denver Office's capabilities. At a cost of \$65 per sample, GE could analyze for PCBs and provide certification of the exact amount of PCBs contained in each sample. They would provide adhesive-backed labels to be attached to Facility transformers, reflecting the individual transformer's PCB classification. General Electric would also maintain appropriate EPA-required analysis records on the transformers. Turnaround time for submitted samples would be two weeks. The \$65-per-sample fee did not, however, include costs related to collecting samples, subcontract and warehouse expenses, or shipping items.

Since GJAO was already equipped with a complete Chemistry Laboratory, Plant Engineering approached R. B. Chessmore, Manager for the Laboratory, to determine whether Bendix could perform this type of PCB analysis of transformer oils. Dr. Chessmore was provided with copies of all related documentation. He then obtained additional information from EPA concerning the actual approved analytical procedure. In mid-October 1981, Dr. Chessmore concluded that, with the purchase of a special detector to be attached to existing lab equipment and a few operating supplies, Bendix could perform the PCB analysis of GJAO transformer oils at the Facility's Chemistry Laboratory. He estimated the cost of the equipment and supplies to be approximately \$3500. Mr. Chessmore recommended the purchase of the equipment to support on-site analysis of PCBs, particularly since the equipment would be a significant contribution to the Bendix Chemistry Laboratory's capabilities.

After considering both options, on-site analysis of the dielectrics was chosen over contracting the sample testing with the GE shop in Denver. Although it would require testing at least 50 samples to break even with the total GE fee, the turnaround time for each sample would be reduced to a few hours. Bendix would maintain all transformer records on-site. The Chemistry Laboratory

would expand their capabilities which could be made available to other DOE agencies and Government facilities. Bendix/DOE would also be able to provide emergency assistance in PCB identification to local power companies and industries, if the need arose.

The Chemistry Laboratory was instructed to procure the necessary equipment to conduct specific PCB level analysis in transformer oils and to establish appropriate lab methodology for this type of analysis. Concurrently, Plant Engineering began to develop a sample collection procedure and determine the best sequence for sample collection.

PHASE 5: CALCULATE PCB LEVELS IN TRANSFORMER FLUIDS (BENDIX OPERATIONS EFFORT)

The sample collection procedure, described in Appendix B, was approved in late October 1981. Steps were included in the procedure to establish an EPA-approved waste disposal site. The procedure was reviewed by the Bendix Safety Engineer, Maintenance Foreman, and Maintenance Electricians to ensure practicality, observation of all appropriate electrical precautions, and minimal possibility of contamination.

The sample collection sequence (see Appendix B), which identifies transformers by Facility equipment preventive maintenance (PM) numbers, was based on each individual transformer and/or substation's impact on the maintenance of Facility operations. Transformers supplying power to noncritical buildings and perimeter lighting and those units in storage were selected early in the sequence to allow time for the craftsmen to develop a routine for sample collection. Transformer substations that provided power to critical equipment or buildings were scheduled for accomplishment later in the sequence. In addition, these latter samples were taken late in the day or on weekends, when Facility power requirements were reduced.

Several transformers that had been in storage when the inventory was conducted had been excessed between May and November 1981. This reduced the total number of units to be sampled by 11, from 54 to 43. In addition, at least 10 percent of the samples were duplicated for verification of the Chemistry Laboratory results. Samples were drawn periodically between November 1981 and February 1982. The final results of the Facility PCB analysis effort, including certificates of assay from the Bendix Chemistry Laboratory, are contained in Appendix C. Detailed information describing the Chemistry Laboratory's efforts in this project is contained in Appendix D. Appendix E provides a cost breakdown for PCB identification, Project No. 4M0189-1495, as performed by Bendix at GJAO.

CONCLUSIONS

No contamination of personnel occurred during extraction or analysis of samples. All waste materials generated during sample extraction were discarded properly, and the waste collection drum is now being prepared for shipment to one of EPA's approved disposal sites.

Plant Engineering was able to maintain total in-house project cost below the estimated cost for subcontracting PCB analysis to General Electric. Thus, the project-related purchases necessary to equip the Chemistry Laboratory are justified.

Of the 51 transformers and disconnects in use at GJAO, 15 units, or 30 percent, were determined to be PCB-Contaminated or filled with PCBs. This number falls within EPA's estimate of 25 to 40 percent of all transformers in use being at least contaminated. Bendix is currently using approximately 324 gallons of PCBs and 515 gallons of PCB-Contaminated fluids. No contaminated transformers or disconnects are in a position to contaminate food or feed products at the Facility.

As a result of this PCB analysis, all units in service and in storage at GJAO are now being labeled to reflect their contamination level. PM procedures for inspection of the transformers and disconnects are being developed. The procedures will meet EPA requirements for inspection of PCB and PCB-Contaminated Transformers. Records for individual transformers and their certificates of assay are now available for review in the Operations Division office.

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- U.S. Environmental Protection Agency, "Polychlorinated Biphenyls; Criteria Modification; Hearings," Federal Register, Vol. 44, No. 106, May 31, 1979, p. 31514-31568.
- U.S. Environmental Protection Agency, "Polychlorinated Biphenyls (PCBs); Court Order, Clarification of Issues, and Proposed Rulemaking," Federal Register, Vol. 46, No. 97, May 20, 1981, p. 27614-27621.

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APPENDIX A: REPORT TO ERDA ON PCB USAGE AT GJO, MAY 1976

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**Field Engineering
Corporation**

P O Box 1569
Grand Junction, CO 81502
Tel (303) 242-8621

Grand Junction Operations

A Subsidiary of
The Bendix Corporation

Mr. Ben Bowyer
Assistant Manager for Operations
U.S. Energy Research and Development
Administration
Grand Junction Office
Grand Junction, Colorado 81501

May 7, 1976

Dear Mr. Bowyer:

In further response to your letter of April 14, 1976 with respect to an inventory of Polychlorinated Biphenyls (PCBs), we are attaching the enclosed chart setting forth information obtained during our inventory.

As indicated on the chart, we have inventoried the location and quantity of polychlorinated biphenyls within the Grand Junction Office based on the information available as to possible sources. It appears that the only significant source of PCBs is the cooling oil contained within the large pole and ground mounted electrical transformers at this site. Where possible, the quantity of oil was recorded directly from the transformers, however, there were many which had no such data stamped on them, nor recorded elsewhere. Data was obtained from the local power companies which enabled us to interpolate quantities of oil for these units. The age of the transformers varies from the early 1940's to two which were installed in 1975 to replace two others which were placed in surplus status after being struck by lightning.

With regard to information requested in Paragraph 3 of the EPA letter, BFEC has no current or projected plans to procure PCBs or products containing them. In addition, it is our intention to establish controls over the purchase of such products. Future plans for the acquisition of PCBs in any form will require the prior approval of BFEC management before proceeding.

In response to EPA letter, Paragraph 4, we are developing procedures to assure disposal of PCB. Discharges will be handled with extreme care by our maintenance personnel. Our future plans for the safe disposal of PCBs include the possibility of leaking ballasts or transformers. As ballasts are replaced, they will be put in a segregated area, such as a drum; the cleanup wipes from any leaking ballast will be bagged and placed in the same container along with any other material suspected of containing PCBs. The cleanup from any

**Field Engineering
Corporation**

Mr. Ben Bowyer

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May 7, 1976

leaking transformers, including contaminated earth, will be handled in a manner similar to that set forth above for leaking ballast and when enough material is accumulated, it will be shipped to a commercial disposal site.

We plan to control the discarding of equipment containing PCBs through our maintenance personnel without reliance on our waste disposal contractor in view of our experience in these matters. We are preparing a letter of instructions to advise operational, maintenance and service personnel of the methods and procedures for handling PCB equipment and controlling PCB discharges. Furthermore, as a result of our inventory, we will be establishing a plan to keep track of all equipment identified as potentially containing PCBs as well as any new equipment approved by management for acquisition.

If you have further questions concerning this matter, please contact Mr. J. N. Watts, Safety Engineer, Human Resources Division.

Very truly yours,

C. L. Greenslit for
C. L. Greenslit

CLG/jeb

TRANSFORMERS		GALS. OF OIL								
Location	Quant. - KVA	Delta Star	Westinghouse	Central Transformer	General Electric	Kuhlman Electric	Electric Service Co.	Allis Chalmers	Brand Name Unknown	Approx. Gals.
Sub Sta. #1	3 ea. 50								X	66
Sub Sta. #2	3 ea. 250				330					
Sub Sta. #3	1 ea. 250				110					
Sub Sta. #3	3 ea. 100				X					99
Sub Sta. #4	3 ea. 100				X					99
Sub Sta. #4	1 ea. 75				X					45
Sub Sta. #5	3 ea. 100			X						99
Sub Sta. #7	3 ea. 50					X				66
Sub Sta. #8	1 ea. 67					93				
Sub Sta. #9	3 ea. 250		392							
Sub Sta. #10	1 ea. 167			102						
Sub Sta. #10	2 ea. 167							84		
Sub Sta. #11	1 ea. 75						X			45
Sub Sta. #13	3 ea. 50	X								66
Main Sub Sta.	3 ea. 500			1,080						
Tr./Pole #41	1 ea. 7				X					5
Tr./Pole #36	1 ea. 7.5								X	5
Tr./Pole #33	1 ea. 7.5			X						5
Tr./Pole #15	1 ea. 25					X				15
Tr./Pole Bldg 28	1 ea. ?								X	5
Tr./near Bldg 8	1 ea. ?								X	5
Tr./Pole #23	1 ea. 7.5								X	5
Trans./Pole #21	1 ea. 37.5							X		18
Trans./Pole #18	1 ea. 37.5		18							
L. Tr./Pole #20	1 ea. ?								X	5
L. Tr. Bldg #7	1 ea. ?								X	5
Lt. Tr. Test Pits	3 ea. 15	X							X	30
Total Gals of Oil									Approx. 2,900	

May 2, 1970

PCBs USED BY GOVERNMENT AGENCIES AND GOVERNMENT CONTRACTORS

	<u>Currently In Use</u>	<u>Annual Additions (1975)</u>	<u>Annual Losses</u>	<u>Individual Units in Service</u>
<u>TRANSFORMERS</u>				
In Buildings				- 0 -
Hospitals				
Offices				
Laboratories				
Residential				
Other				
Transportation				- 0 -
Rail Facilities				
Ships				
Other				
Industrial Facilities	1900 Gal.	84 Gal. ¹	204 Gal. ²	48
Other	of oil.			
<u>LARGE CAPACITORS (>2 lbs)</u>				
Electrical Systems				- 0 -
Land Distribution				
Station				
Transportation				
Other				
Industrial Facilities				- 0 -
Other				
<u>SMALL CAPACITORS</u>				
Consumer Items	456 lbs. ³	12 lbs. ⁴	12 lbs. ⁵	1850 ballasts ⁶
Lights				
Television Sets				
Air Conditioners				
Other				
Industrial Facilities	12	- 0 -	- 0 -	50 ⁷
Motors				
Other				
Other				
<u>OPEN SYSTEM USES</u>				
Hydraulic Systems				- 0 - ⁸
Underground Equipment				
Other				
Lubricants				- 0 -
Heat Transfer Fluids				- 0 -
Investment Casting Wax				- 0 -
Other				- 0 -
<u>PAPER PRODUCTS</u>				
Carbonless Copy Paper				- 0 - ⁹
Utilized Supplies				
Adhesives on Boxes				- 0 - ¹⁰
Utilized Supplies				
Other				

Note: Indicate which items refer to Agency activities and which refer to contractor activities. The estimates should be set forth in 1,000 of pounds. An error of not more than 10 percent is acceptable.

FOOTNOTES

- ¹Two transformers struck by lightning in 1975 and replaced by two new transformers containing 42 gallons of cooling oil each.
- ²Assumes that two old transformers which were sold as surplus may have had PCB oil disposed of into environment.
- ³Assumes that estimated 1,800 ballasts each contain .25 lb. of PCBs.
- ⁴Based upon warehouse receipts, assumes that about 50 ballasts are replaced each year.
- ⁵Based on the above figures, it can be assumed that during the past 20 years, about 250 lbs. of PCBs may have gone into the GJO burial sites.
- ⁶Based upon an average of 12 ballasts per 1,000 sq. ft., and allowing for low lighted areas in most buildings, GJO contains about 2,000 ballasts of which about 150 have been replaced during the past three years with ballasts not containing PCBs.
- ⁷Assumes all 50 air conditioner motors at GJO may contain PCBs in $\frac{1}{4}$ lb. per capacitor.
- ⁸As PCB fluids are not flammable, Jack Bane, ERDA Headquarters, said not to consider normal hydraulic fluids, oils, or greases as PCB material.
- ⁹As PCBs have not been manufactured in this country since 1972, it is assumed that carbonless copy paper purchases since that date contains none. Our supplies on hand have all been purchased since that date.
- ¹⁰Jack Bane, ERDA Headquarters, said considering the size of GJO, not to consider this item.

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**APPENDIX B: TRANSFORMER SAMPLE COLLECTION PROCEDURE, INVENTORY,
AND COLLECTION SEQUENCE AT GJAO, 1981-1982**

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TRANSFORMER SAMPLE COLLECTION PROCEDURE

REQUIRED MATERIALS

- . 120 6-Dram Glass Vials with Teflon-Lined Plastic Caps
- . 30 Disposable 100-Milliliter Plastic Cups
- . 2 Boxes of Disposable Plastic Gloves
- . Coveralls
- . Rags
- . Plastic Trash Bags
- . Appropriate High-Voltage Safety Equipment

PRELIMINARY STEPS

Prior to beginning this procedure, a waste disposal container site must be created in the following manner:

1. Set up a 55-gallon drum at the south end of the compound near Building 35. (Ensure the drum meets Department of Transportation approval for shipping.)
2. Paint the words "CAUTION -- PCBs" on the outside of the drum.
3. Place several inches of sawdust in the bottom of the drum.
4. Line the drum with a 55-gallon-capacity plastic bag.
5. Provide a cover that can be tightly sealed.

COLLECTION PROCEDURE

NOTE

This procedure should be followed without deviation. If any problems or questions arise, stop work and immediately contact the Maintenance Planner in Plant Engineering.

WARNING

Working in and around high-voltage equipment is dangerous. Personnel must review Safety Sections 1.6.2 through 1.6.6 of the Facility PM Manual prior to beginning this procedure. A two-man rule is in effect while isolating transformers, collecting samples, and when restoring transformers to load conditions.

1. Using adhesive tape, label the outside of each empty vial with the appropriate transformer PM number and substation location. Vials to be used for units in storage should include appropriate transformer manufacturer names, serial numbers, and KVA ratings on the label. Two vials should be labeled for each transformer. Transformers selected for duplicate samples (see Sample Sequence) should have four vials labeled.
2. Isolate or disconnect the transformer or substation.
3. Disconnect the primary voltage input to the appropriate transformer or substation.
4. Remove all transformer covers at the substation.

NOTE

All samples will be taken from the top of the transformer reservoir to ensure they are clean and sediment-free and to give electricians the opportunity to inspect transformer interiors.

5. Put on a pair of disposable plastic gloves. Dip a 100-ml plastic cup into the transformer reservoir until a sufficient amount of dielectric is collected in it to fill both sample vials at least 80 percent full.
6. Place a rag under the vials to collect spills. Carefully pour the dielectric from the cup into the two sample vials until both are at least 80 percent full. Pour any remaining dielectric back into the transformer reservoir. Screw the teflon-lined caps onto the sample vials.

CAUTION

If any spillage occurs during the preceding step, contaminated articles and/or contaminated earth must be placed into the waste-disposal container as soon as possible.

7. Wipe the outside of the cup with the rag to collect any excess oil. Place the cup in a plastic trash bag. Ensure the outside of the sample vials are clean and oil-free. Place the contaminated rag and gloves in the plastic trash bag.
8. Place the filled vials in the carrying case provided. Obtain a new cup, the appropriate sample vials, and gloves, and repeat Steps 2 through 7 for each unit at the substation.
9. Replace the transformer cover(s). Reconnect the primary voltage input to the transformer or substation. Place the transformer or substation back on-line.
10. When a trash bag is full of contaminated materials, seal it and place it in the waste-disposal container. Ensure the container is properly sealed after disposing of the waste material.
11. Return collected samples to the Maintenance Planner at the end of each day.

TRANSFORMER INVENTORY

The following inventory lists all Facility transformers, their location, and assigned PM Number (also see Figure B-1). The first group consists of transformers in use; the second group reflects transformers in storage. Nine of the transformers listed here were not tested for PCB analysis (see Sample Collection Sequence).

TRANSFORMERS IN SERVICE

<u>Manufacturer/Specifications</u>	<u>Location</u>	<u>PM No.</u>
Central Transformer Corp. Type AOD - 500 KVA SN 2760-2/SPEC W-2093 7620, 13200, 22860v pri - 2400, 4160v sec/60Hz/1 Ph; 55°C TR Cap.: 360 gals. inhibited oil Wt.: 7640 lbs. PCB Type: Non-PCB	Main Substation	ET01
Central Transformer Corp. Type AOD - 500 KVA SN 2760-3/SPEC W-2093 7620, 13200, 22860v pri - 2400, 4160v sec/60Hz/1 Ph; 55°C TR Cap.: 360 gals. inhibited oil Wt.: 7640 lbs. PCB Type: Non-PCB	Main Substation	ET02
Central Transformer Corp. Type AOD - 500 KVA SN 2760-1/SPEC W-2903 7620, 13200, 22860v pri - 2400, 4160v sec/60Hz/1 Ph; 55°C TR Cap.: 360 gals. inhibited oil Wt.: 7640 lbs. PCB Type: Non-PCB	Main Substation	ET03
Central Transformer Corp. Type AOD - 100 KVA SN 3069-2/SPEC 3619-A 2400, 4160v pri - 120, 240v sec/60Hz/1 Ph; 55°C TR Cap.: 40 gals. oil Wt.: 1240 lbs. PCB Type: Non-PCB	Substation 1	ET04

<u>Manufacturer/Specifications</u>	<u>Location</u>	<u>PM No.</u>
Central Transformer Corp. Type AOD - 100 KVA SN 3058-1/SPEC 3619-A 2400, 4160v pri - 120, 240v sec/60Hz/1 Ph; 55°C TR Cap.: 40 gals. oil Wt.: 1240 lbs. PCB Type: Non-PCB	Substation 1	ET05
Central Transformer Corp. Type AOD - 100 KVA SN 3058-6/SPEC 3619-1 2400, 4160v pri - 120, 240v sec. 60Hz/1 Ph; 55°C TR Cap.: 40 gals. oil Wt.: 1240 lbs. PCB Type: Non-PCB	Substation 1	ET06
General Electric Type Spirakore - 250 KVA SN C383354 2400, 4160v pri - 120, 240v sec/60Hz/3 Ph; 55°C TR Cap.: 110 gals. #10C oil Wt.: 2900 lbs. PCB Type: PCB-Contaminated	Substation 2	ET07
General Electric Type Spirakore - 250 KVA SN C647287 2400, 4160v pri - 120, 240v sec/60Hz/3 Ph; 55°C TR Cap.: 110 gals. #10C oil Wt.: 2900 lbs. PCB Type: PCB-Transformer	Substation 2	ET08
General Electric Type Spirakore - 250 KVA SN C647180 2400, 4160v pri - 120, 240v sec/60Hz/3 Ph; 55°C TR Cap.: 110 gals. #10C oil Wt.: 2900 lbs. PCB Type: PCB-Transformer	Substation 2	ET09
General Electric Type Spirakore - 100 KVA SN C663198 2400, 4160v pri - 120, 240v sec/60Hz/1 Ph; 55°C TR Cap.: 47 gals. #10C oil Wt.: 1210 lbs. PCB Type: PCB-Contaminated	Substation 3	ET10

<u>Manufacturer/Specifications</u>	<u>Location</u>	<u>PM No.</u>
General Electric Type Spirakore - 100 KVA SN C672577 2400, 4160v pri - 120, 240v sec/60Hz/1 Ph; 55°C TR Cap.: 47 gals. #10C oil Wt.: 1210 lbs. PCB Type: PCB-Contaminated	Substation 3	ET11
General Electric Type Spirakore - 100 KVA SN C672588 2400, 4160v pri - 120, 240v sec/60Hz/1 Ph; 55°C TR Cap.: 47 gals. #10C oil Wt.: 1210 lbs. PCB Type: PCB-Contaminated	Substation 3	ET12
General Electric Type HS - 100 KVA SN B333887 2400, 4160v pri - 120, 240v sec/60Hz/1 Ph; 55°C TR Cap.: 52 gals. #10C oil Wt.: 1350 lbs. PCB Type: PCB-Transformer	Substation 4	ET13
General Electric Type HS - 100 KVA SN B333842 2400, 4160v pri - 120, 240v sec/60Hz/1 Ph; 55°C TR Cap.: 52 gals. #10C oil Wt.: 1350 lbs. PCB Type: PCB-Transformer	Substation 4	ET14
General Electric Type HS - 100 KVA SN B333889 2400, 4160v pri - 120, 240v sec/60Hz/1 Ph; 55°C TR Cap.: 52 gals. #10C oil Wt.: 1350 lbs. PCB Type: PCB-Contaminated	Substation 4	ET15
General Electric 750 KVA SN G8522448A 2400, 4160v pri - 120, 208v sec/60Hz/3 Ph; 55°C TR Cap.: 215 gals. #10C oil Wt.: 7100 lbs. PCB Type: Non-PCB (not tested)	Substation 5	ET16

Manufacturer/SpecificationsLocationPM No.

Allis-Chalmers
Type Curvacore - 100 KVA
SN 3135976
4160, 7200v pri - 120, 240v
sec/60Hz/3 Ph; 55°C TR
Cap.: 36 gals. fluid
Wt.: 1155 lbs.
PCB Type: PCB Contaminated

Substation 7

ET17

Westinghouse
Style 12V115N - 100 KVA
SN 585E523
4160, 7200v pri - 120, 240v
sec/60Hz/3 Ph; 55°C TR
Cap.: 35 gals. fluid
Wt.: 1150 lbs.
PCB Type: Non-PCB

Substation 7

ET18

Westinghouse
Style 12V115N - 100 KVA
SN 585E526
4160, 7200v pri - 120, 240v
sec/60Hz/3 Ph; 55°C TR
Cap.: 36 gals. fluid
Wt.: 1150 lbs.
PCB Type: Non-PCB

Substation 7

ET19

Kuhlman Transformer Co.
Type KE - 167 KVA
SN C26262
2400, 4160v pri - 124, 240v
sec/60Hz/1 Ph; 55°C TR
Cap.: 93 gals. mineral oil
Wt.: 2540 lbs.
PCB Type: Non-PCB

Substation 8

ET20

Central Transformer Corp.
Type AOD - 167 KVA
SN 2467-3/SPEC 1945 - C
2400, 4160v pri - 240, 440v
sec/60Hz/3 Ph; 55°C TR
Cap.: 102 gals. inhibited oil
Wt.: 2550 lbs.
PCB Type: Non-PCB

Substation 10

ET24

<u>Manufacturer/Specifications</u>	<u>Location</u>	<u>PM No.</u>
Allis-Chalmers Type SB - 167 KVA SN 3069459 2400, 4160v pri - 240 480v sec/60Hz/1 Ph; 55°C TR Cap.: 48 gals. oil (DBPC) Wt.: 1495 lbs. PCB Type: Non-PCB	Substation 10	ET25
Allis-Chalmers Type SB-167 KVA SN 3310861 2400, 4160v pri - 240 480v sec/60Hz/1 Ph; 55°C TR Cap.: 42 gals. oil (DBPC) Wt.: 1520 lbs. PCB Type: Non-PCB	Substation 10	ET26
Electrical Services Co. (ESCO) Type 01SC - 100 KVA SN 4008 (Form W) 480v pri - 120, 240v sec/ 60Hz/1 Ph; 55°C TR Cap.: 60-75 gals. oil PCB Type: Non-PCB	Substation 11	ET27
T&R Electric 150 KVA SN 00780 2500, 4160v pri - 120, 208v sec/60Hz/3 Ph; 55°C TR PCB Type: Non-PCB (not tested)	Substation 13	ET28
Westinghouse Type Insulour - 150 KVA Style A23A4906PM SN 77G487274 2400, 4160v pri - 120, 208v sec/60Hz/3 Ph; 55°C TR Wt.: 3000 lbs. PCB Type: Non-PCB (not tested)	Substation 14	ET29
Delta-Star Transformer Co. Type OS - 15 KVA SN W-215296 4160, 7200v pri - 120, 240v sec/60Hz/1 Ph; 65°C TR PCB Type: Non-PCB	Substation 15	ET45

<u>Manufacturer/Specifications</u>	<u>Location</u>	<u>PM No.</u>
Delta-Star Transformer Co. Type OS - 15 KVA SN W-215299 4160, 7200v pri - 120, 240v sec/60Hz/1 Ph; 65°C TR PCB Type: Non-PCB	Substation 15	ET46
Delta-Star Transformer Co. Type OS - 15 KVA SN W-215295 4160, 7200v pri - 120, 240v sec/60Hz/1 Ph; 65°C TR PCB Type: Non-PCB	Substation 15	ET47
Kuhlman Transformer Co. 15 KVA SN C51903 2400, 4160v pri - 120, 240v sec/60Hz/1 Ph Cap.: 30 gals. #10C oil PCB Type: Non-PCB	Pole 25	ET31
Delta-Star Transformer Co. Type OS (D02C) - 50 KVA SN W168859 NPW 4021 2400, 4160v pri - 120, 240v sec/60Hz/1 Ph Cap.: Unknown amt. oil Wt.: 700 lbs. PCB Type: Non-PCB	Pole 47	ET32
General Electric Type H - 5 KVA SN 4305225 208, 2155v pri - 115, 230v sec/60Hz/1 Ph Cap.: 5.5 gals. #10C oil PCB Type: Non-PCB	Pole 53	ET33
Westinghouse 15 KVA 2400, 4160v pri - 120, 240v sec/60Hz/1 Ph Cap.: 5.5 gals. fluid PCB Type: Non-PCB	Pole 54	ET34
Central Transformer Corp. 10 KVA SN 23535 2400, 4160v pri - 110, 220v sec/60Hz/1 Ph Cap.: 5.5 gals. fluid PCB Type: Non-PCB	Pole 66	ET35

<u>Manufacturer/Specifications</u>	<u>Location</u>	<u>PM No.</u>
Westinghouse 10 KVA SN 1643676 2400, 4160v pri - 120, 240v sec/60Hz/1 Ph Cap.: 5.5 gals. fluid PCB Type: Non-PCB	Pole 69	ET36
General Electric 7.5 KVA SN 6699142 2400, 4160v pri - 120, 240v sec/60Hz/1 Ph Cap.: 9 gals. #10C oil PCB Type: PCB-Contaminated	Pole 75	ET37
General Electric Type 56P - 25 KVA SN C569862 2400, 4160v pri - 120, 240v sec/60Hz/1 Ph Cap.: Unknown amt. #10C oil PCB Type: PCB-Contaminated	Pole 98	ET38
General Electric Type JE3 - 200 VA Model 9JE3CAR3 SN 9212690 2400v pri - 120v sec/60Hz/1 Ph; Impulse 60 KV PCB Type: Non-PCB (not tested)	Pole 91	ET39
General Electric Type JE3 - 200 VA Model 9JE3CAR3 SN 9212759 2400v pri - 120v sec/60Hz/60 KV PCB Type: Non-PCB (not tested)	Pole 91	ET40
General Electric Type JE3 - 200 VA Model 9JE3CAR3 SN9212695 2400v pri - 120v sec/60Hz/1 Ph; Impulse 60 KVA PCB Type: Non-PCB (not tested)	Pole 91	ET41

<u>Manufacturer/Specifications</u>	<u>Location</u>	<u>PM No.</u>
General Electric (I) Type JW14 - 5KVA Model DAW4 SN A711349 200A pri - 5A sec/60Hz PCB Type: Non-PCB (not tested)	Pole 91	ET42
General Electric (I) Type JW14 - 5 KVA Model DAW4 SN A711350 200A pri - 5A sec/60Hz PCB Type: Non-PCB (not tested)	Pole 91	ET43
General Electric (I) JW14 - 5 KVA Model DAW4 SN A711348 200A pri - 5A sec/60Hz PCB Type: Non-PCB (not tested)	Pole 91	ET44

TRANSFORMERS IN STORAGE

<u>Manufacturer/Specifications</u>	<u>Location</u>	<u>PM No.</u>
General Electric 37.5 KVA SN 6876849 2400, 4160v pri - 120, 240v sec/60Hz/1 Ph PCB Type: PCB-Contaminated	S. Storage Yard	ET30
Delta-Star 50 KVA SN 168880 PCB Type: Non-PCB	S. Storage Yard	--
Delta-Star 50 KVA SN 168866 PCB Type: Non-PCB	S. Storage Yard	--
Delta-Star 50 KVA SN 168856 PCB Type: Non-PCB	S. Storage Yard	--
General Electric 250 KVA SN C6447488 Cap.: 115 gals. #10CA oil PCB Type: PCB-Contaminated	S. Storage Yard	--

Figure B-1. PCB Status of Facility Transformers and Disconnects

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TRANSFORMER SAMPLE COLLECTION SEQUENCE

The following list indicates the sequence by which sample collections should be conducted. Transformers are identified by their unique PM number and location (see preceding inventory for additional information about each unit). Those marked with an asterisk (*) will require two samples to be taken instead of one. The duplicate sample will be used to verify analytical procedures. Items marked with a plus sign (+) will be done only on weekends or holidays. Those units marked with a sharp sign (#) should be done late in the day (after 3:00 p.m.) between Monday and Friday. Whenever necessary, ensure affected divisions and department heads are given a two-day notice prior to shutting down power.

<u>Collection Sequence</u>	<u>Transformer</u>	<u>Location</u>
1.	ET21	Substation 9
2.	ET22	Substation 9
3.	ET23	Substation 9
*4.	ET27	Substation 11
*5.	ET45	Substation 15
6.	ET46	Substation 15
7.	ET47	Substation 15
8.	Delta-Star, SN 168880, 50 KVA	S. Storage Yard
9.	Delta-Star, SN 168866, 50 KVA	S. Storage Yard
10.	Delta-Star, SN 168856, 50 KVA	S. Storage Yard
11.	General Electric, SN C6447488, 250 KVA	S. Storage Yard
+12.	ET04	Substation 1
+13.	ET05	Substation 1
+14.	ET06	Substation 1
*+15.	ET07	Substation 1
+16.	ET08	Substation 2
+17.	ET09	Substation 2
18.	ET38	Pole 98
19.	ET31	Pole 25
*20.	ET30	S. Storage Yard
+21.	ET10	Substation 3
+22.	ET11	Substation 3
+23.	ET12	Substation 3
#24.	ET13	Substation 4
#25.	ET14	Substation 4
#26.	ET15	Substation 4
27.	ET32	Pole 47
28.	ET37	Pole 75
29.	ET33	Pole 53
30.	ET34	Pole 54
31.	ET20	Substation 8
32.	ET36	Pole 69
*33.	ET35	Pole 66
34.	ET24	Substation 10
35.	ET25	Substation 10

<u>Collection Sequence</u>	<u>Transformer</u>	<u>Location</u>
36.	ET26	Substation 10
+37.	ET17	Substation 7
+38.	ET18	Substation 7
+39.	ET19	Substation 7
+40.	ET01	Main Substation
*+41.	ET02	Main Substation
+42.	ET03	Main Substation
*43.	Oil Disconnect Switches (3)	Poles 76, 77, 94

The following transformers will not be tested:

ET16 at Substation 5
ET28 at Substation 13
ET29 at Substation 14
ET39, ET40, ET41, ET42, ET43, and ET44 on Pole 91

APPENDIX C: RESULTS OF PCB ANALYSES AT GJAO, 1981-1982

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TRANSFORMERS AND OIL DISCONNECTS: INVENTORY AND PCB ANALYSIS SUMMARY

TRANSFORMER INVENTORY

Transformers in Service - 43 (includes 9 units that were not tested)
Transformers in Storage - 5
Total 48 (see inventory breakdown, Appendix B)

OIL DISCONNECT INVENTORY

Disconnects in Service - 3
Disconnects in Storage - 0
Total 3 (inventory breakdown not available)

PCB ANALYSIS SUMMARY

Type	Number	Approx. Gallons of Liquid
PCB-Transformers/Disconnects	4	324.0
PCB-Contaminated Transformers/ Disconnects	11	515.0
Non-PCB Transformers/ Disconnects	36	2043.0
Total	51	2882.0

BENDIX CERTIFICATES OF ASSAY

The following four reports are the Certificates of Assay for the samples tested by the Bendix Chemistry Laboratory. Duplicate sample tests are shown. The exact PCB level for each transformer is cited in the column "ppm PCB."

BENDIX FIELD ENGINEERING CORP.

P.O. BOX 1569

Grand Junction, Colorado 81502

CERTIFICATE OF ASSAY

REQUESTED BY M.E. Miller REQUISITION NO. 700110 DATE Nov. 23, 1981

Facility PCB Analysis - PCB's in transformer oils

	<u>Lab No.</u>	<u>ppm PCB</u>	<u>PM No.</u>	<u>Location</u>
*MKO 876	78964	10	ET21	Substation 9
*MKO 877	78965	32	ET22	Substation 9
*MKO 878	78966	35	ET23	Substation 9
+MKO 879	78967	10	ET27	Substation 11
+MKO 880	78968	12	ET27	(duplicate)

* Units excessed in December 1981.

+ Units on excess; inactive.

BFE 1412
12/16/80

SENIOR ANALYST

BENDIX FIELD ENGINEERING CORP.

P.O. BOX 1569

Grand Junction, Colorado 81502

CERTIFICATE OF ASSAY

REQUESTED BY M.E. Miller REQUISITION NO. 700111 DATE Feb. 12, 1982

PCB

	<u>Lab No.</u>	<u>ppm PCB</u>	<u>PM No.</u>	<u>Location</u>
MKO 881	79013	8	ET45	Substation 15
MKO 882	79014	9	ET45	(duplicate)
MKO 883	79015	14	ET46	Substation 15
MKO 884	79016	< 5	ET47	Substation 15
MKO 885	79017	< 5	Delta-Star SN 168880	Storage
MKO 886	79018	< 5	Delta-Star SN 168866	Storage
MKO 887	79019	< 5	Delta-Star SN 168856	Storage
MKO 888	79020	178	GE SN C6447488	Storage

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12/16/80

Nic Korte
SENIOR ANALYST

BENDIX FIELD ENGINEERING CORP.

Page 1 of 2

P.O. BOX 1569

Grand Junction, Colorado 81502

CERTIFICATE OF ASSAY

REQUESTED BY - M.E. Miller REQUISITION NO. 700112 DATE Feb. 12, 1982

PCB

	<u>Lab No.</u>	<u>ppm PCB</u>	<u>PM No.</u>	<u>Location</u>
MK0 889	79133	< 5	ET04	Substation 1
MK0 890	79134	< 5	ET05	Substation 1
MK0 891	79135	< 5	ET06	Substation 1
MK0 892	79136	358	ET07	Substation 2
MK0 893	79137	335	ET07	(duplicate)
MK0 894	79138	520	ET08	Substation 2
MK0 895	79139	520	ET09	Substation 2
MK0 896	79140	248	ET38	Pole 98
MK0 897	79141	260	ET30	Pole 38
MK0 898	79142	262	ET30	(duplicate)
MK0 899	79143	< 5	ET31	Pole 25
MK0 900	79144	426	ET10	Substation 3
MMP 701	79145	245	ET11	Substation 3
MMP 702	79146	237	ET12	Substation 3

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12/16/80

SENIOR ANALYST

P.O. BOX 1569

Grand Junction, Colorado 81502

CERTIFICATE OF ASSAY

REQUESTED BY M.E. Miller REQUISITION NO. 700112 DATE Feb. 12, 1982

PCB	<u>Lab No.</u>	<u>ppm PCB</u>	<u>PM No.</u>	<u>Location</u>
MMP 703	79147	510	ET13	Substation 4
MMP 704	79148	667	ET14	Substation 4
MMP 705	79149	344	ET15	Substation 4
MMP 706	79150	< 5	ET32	Pole 47
MMP 707	79151	94	ET37	Pole 75
MMP 708	79152	< 5	ET33	Pole 53
MMP 709	79153	35	ET34	Pole 54
MMP 710	79154	< 5	ET20	Substation 8
MMP 711	79155	7	ET36	Pole 69
MMP 712	79156	< 5	ET35	Pole 66
MMP 713	79157	< 5	ET35	(duplicate)
MMP 714	79158	42	ET24	Substation 10
MMP 715	79159	< 5	ET25	Substation 10
MMP 716	79160	21	ET26	Substation 10

BFE 1412
12/16/80

SENIOR ANALYST

BENDIX FIELD ENGINEERING CORP.

P.O. BOX 1569

Grand Junction, Colorado 81502

CERTIFICATE OF ASSAY

REQUESTED BY M.E. Miller REQUISITION NO. 700113 DATE Feb. 12, 1982

PCB

	<u>Lab No.</u>	<u>ppm PCB</u>	<u>PM No.</u>	<u>Location</u>
MMP 718	79265	58	ET17	Substation 7
MMP 719	79266	46	ET18	Substation 7
MMP 720	79267	< 5	ET19	Substation 7
MMP 721	79268	13	ET01	Main Substation
MMP 722	79269	24	ET02	Main Substation
MMP 723	79270	22	ET02	(duplicate)
MMP 724	79271	16	ET03	Main Substation
MMP 725	79272	< 5	Disconnect	Pole 94
MKO 857	79273	52	Disconnect	Pole 76
MKO 858	79274	< 5	Disconnect	Pole 78
MKO 859	79275	7	Disconnect	(duplicate)

BFE 1412
12/16/80

Mac Dote

SENIOR ANALYST

**APPENDIX D: METHODOLOGY FOR PCB ANALYSIS, BENDIX
CHEMISTRY LABORATORY, 1981-1982**

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METHODOLOGY FOR PCB ANALYSIS TRANSFORMER FLUIDS

Two draft procedures are available for the gas chromatographic (GC) analysis of PCBs in transformer oils, one from EPA* and the other from the American Society of Testing Materials (ASTM).† The general methodology of these two procedures was used in development of the chemical analysis method employed by the Bendix Chemistry Laboratory to test for PCBs. This method is summarized below.

INSTRUMENTATION AND ACCESSORIES

Instrumentation consisted of a Varian 3700 gas chromatograph with a ^{63}Ni ECD and a Varian VISTA 401 data system. The column used was a 200 cm x 2 mm glass, 3 percent OV-1/chromosorb W-HP(80/100). The standards used were 1 ug/ul Aroclors from Supelco Kit PCB-A-21.

Gas chromatograph conditions were as follows:

Carrier Gas: N_2 , 25 ml/min
Oven Temperature: 200°C
Injector Temperature: 230°C
Detector Temperature: 300°C

PROCEDURE

The procedure closely followed the EPA and ASTM methods, which are similar in many respects.

One gram of transformer oil was weighed into a 100-ml volumetric flask and diluted to volume with hexane. Impurities were removed by treatment with sulfuric acid and florisil, as described in both the EPA and ASTM methods. One ul of the treated sample was then injected onto the GC column. Samples containing total PCBs greater than 100 ppm were further diluted by 1/10.

QUALITATIVE ANALYSIS

Several potential Aroclor mixtures may be found in transformer oils. Chromatograms of these Aroclors (see, for example, Figure D-1) exhibit a number of peaks resulting in a reproducible and readily recognizable peak pattern. Identification of an unknown PCB may then be accomplished by comparison of the unknown peak pattern to the standard Aroclor pattern.

*Thomas A. Bellar and James J. Lichtenberg, "The Determination of Polychlorinated Biphenyls in Transformer Fluid and Waste Oil," U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Office of Research and Development, Cincinnati, Ohio, June 24, 1980.

†American Society of Testing Materials, "Analysis of Polychlorinated Biphenyls in Mineral Insulating Oils by Gas Chromatography," Draft Proposal PCB 29834-4, Annual Book of ASTM Standards, Part 40, 1981.

Chart Speed 0.6 cm/min
 Atten. 32 Zero: 5% 1 min/tick

Recalc

Title: PCB Analysis

13:53 20 Mar 81

Channel No: 1

Sample: PCB-1254

Method: P

Peak No	Peak Name	Result ppm	Time (min)	Area Counts	Sep Code
1	1254	50.00	17.750	2945020	G

TOTALS	50.00	2945020
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Group #	Result
1	50.00

Divisor: 1.00000 Multiplier: 1.00000

Notes:

ECD @ 300c, Range = 1
 Column @ 200c Isothermal
 Flow = 25cc/min
 Injector @ 250c

Figure D-1. Chromatogram of Aroclor 1254

QUANTITATIVE ANALYSIS

Once the unknown PCB has been correctly matched to an Aroclor standard, quantitation may be accomplished by using a method of peak grouping and external standardization. Calibration factors (CFs) are generated for the Aroclor standards based on peak area (A):

$$\text{CF Group} = \frac{\text{Conc. PCB}}{\text{A Group}}$$

The concentration in the unknown is then calculated:

$$\text{Conc.} = \text{CF Group} \times \text{A Group}$$

DETECTOR SUPPRESSION

Coelution of the mineral transformer oils with the PCB occurs in this analysis. This results in a decrease in the intensity of the PCB signal.

The degree of suppression varies with the amount of oil. A solution containing 1 percent oil shows a suppression of about 15 percent, while a 0.1 percent solution shows a suppression of about 5 percent. A method of PCB spiking and re-analysis of the sample solution is used to indicate the amount of suppression. Results reported out are corrected for the suppression found.

ANALYSIS OF EPA QUALITY CONTROL SAMPLES

A set of three quality control check samples available from EPA were analyzed regularly by the Bendix Laboratory as a quality control check. Results on these three samples, obtained by the Bendix method of PCB analysis as described herein, are shown in Table D-1. A chromatogram of one of these samples, Ampule 2, is shown in Figure D-2.

Table D-1. PCB Analyses of EPA Quality Control Samples (ppm)

Ampule	Specific	Found
1	498	505
2	54	49
3	18	17

Chart Speed 0.6 cm/min
 Atten: 32 Zero: 5% 1 min/tick

Recalc

Title: PCB Analysis

10:29 27 Mar 81

Channel No: 1

Sample: EPA-2

Method: P

Peak No	Peak Name	Result ppm	Time (min)	Area Counts	Sep Code
1	EPA-2	502.00	17.750	3942150	G
TOTALS		502.00		3942150	

Group # 1 Result 502.00

Divisor: 1.00000 Multiplier: 1.00000

Notes:

ECD @ 300C, Range = 1
 Column @ 200c Isothermal
 Flow = 25cc/min
 Injector @ 250c

Figure D-2. Chromatogram of EPA Ampule 2

APPENDIX E: PCB ANALYSIS: PROJECT COST BREAKDOWN

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COST BREAKDOWN FOR PROJECT NO. 4M0189-1495

MATERIALS

Low-Value Capital Equipment (detector for gas chromatograph)	\$1,825.00	
Operating Supplies (includes field supplies, lab supplies, and 55-gallon waste drum)	1,025.00	
Adhesive-Backed PCB ID Labels	<u>64.50</u>	
Total Material Cost		\$2,914.00

LABOR

Administration (120 hours)	\$1,170.00	
Sample Collection (52.4 hours)	525.00	
Sample Analysis (374.6 hours)	<u>3,528.00</u>	
Total Labor Cost		<u>\$5,223.00</u>
TOTAL PROJECT COST		<u>\$8,137.00</u>

COMPARISON OF PER-SAMPLE COSTS

Bendix Cost per Sample (52 samples; less cost of low-value capital equipment)	\$121.38
GE-Contracted Estimated Cost per Sample (does not include costs related to establishing contracts or shipping samples to job facility)	\$122.87